CHAPTER 1 NEW MEXICO: A GEOGRAPHICAL DESCRIPTION

New Mexico is characterized by high mountains, extensive plains and plateaus, river gorges, and broad valleys. Figure 1-1 locates New Mexico with reference to her neighbors and shows the principal towns, rivers, and road networks. The state's climate is arid to semiarid. Average annual precipitation ranges from less than eight inches in desert valleys to over 30 inches in the mountains. About half the annual precipitation is received during brief but intense summer storms. Much of the winter precipitation falls as snow in the high mountains and as snow or rain at lower elevations. Statewide, the annual average precipitation is much less than evaporation from open water surfaces (Bureau of Reclamation 1976). Land surface elevations in New Mexico vary from just over 13,000 feet in the northern mountains to just under 3,000 feet at the Texas border in the southeast.New Mexico is the fifth largest of the fifty states, with a total area of 121,598 square miles. Of this total, 34.2 % are federal lands, 11.8% are State lands, 9.4% are Native American lands, and 44.6% is privately owned. In 1982, about 84 % of all land in New Mexico was used for grazing (Soil and Water Conservation Division 1986). Just over 80% of non-federal New Mexico land was used for pasture and rangeland in 1982, while urban and built-up land constituted about 1.25% of the state's non-federal land area (Williams 1986). In 1992, pasture and rangeland occupied about 82% of all land (Agriculture Statistics Service 1992). Cropland uses about 3.3% of all land of which about 56% of that amount was used for irrigated agriculture (Lanceford 1992).

From a count of just over 1.5 million in 1990, the population increased 2.75% due to migration from out-of-state, and 13.5% from in-state natural increase (births minus deaths) to a 2000 total of just over 1.8 million people (Bureau of Business and Economic Research 2001). The population is expected to reach about two million within the next three years (US Census Bureau 2000). Despite a rapid rate of increase compared to the nation, the state remains sparsely settled overall.

Population centers are associated with available surface and ground water. While some communities are located over large underground aquifers, the environmentally sensitive river valleys and flood plains, which often contain shallow aquifers, are foci for population density (Williams 1986). Albuquerque, on the Rio Grande near the center of the state, is by far the largest city. Containing one-quarter of the total state population within its metropolitan area, it is currently estimated to be more than three times larger than either of the next two cities in size, Las Cruces near the Texas border to the south and Santa Fe to the north.

New Mexico has a small and relatively poor regional economy. In 2002 for instance, New Mexico had a per capita personal income of $23,081. This rating ranked 48th out of the entire United States and was 76 percent of the national average, $30,413 (Bureau of Economic Analysis 2003). Services and government-affiliated jobs are the leading non-agricultural employment sectors, followed by wholesale/retail trade. Manufacturing is fifth, providing over six percent of jobs. New Mexico also has a diversified natural resource extraction industry. The largest industries in 1999 were services, 27.7 percent of earnings; state and local government, 17.9 percent; and retail trade, 10.7 percent. Of the industries that accounted for at least 5 percent of earnings in 1999, the slowest growing from 1998 to 1999 was federal civilian government (6.6 percent of earnings in 1999), which decreased 1.4 percent; the fastest were finance, insurance, and real estate (5.4 percent of earnings in 1999), which increased 7.4 percent (Bureau of Business and Economic Research 2000).

In New Mexico, the State estimates that there are approximately 6,000 miles of perennial rivers and streams. EPA has issued a preliminary estimate of 110,741 miles of rivers, streams, ditches, and canals for New Mexico. Of these, 8,682 are classified perennial (Office of Water 1993). New Mexico estimated the length of its perennial streams by the use of a map wheel on a full set of United States Geological Survey's (USGS) 1:24000-scale topographic maps. Only the cartographic symbols for perennial streams were used. EPA relied on its *Reach File 3* (RF3) database, created from the USGS's Digital Line Graph (DLG) database. This dataset was in turn developed from 1:100000-scale maps. The difference in map scales may ac-

count for much of the difference in total perennial stream lengths. Additionally, since the two agencies may have used maps which were updated from satellite or aerial photos taken at different times, potentially at different times of the year, there is further reason to believe the estimates might differ (Office of Water 1993).

The State has identified approximately 175 freshwater, publicly accessible lakes and reservoirs, approximately fifty of which are over 200 acres in area. According to EPA's preliminary estimate, New Mexico has 1,256 lakes (Office of Water 1993).

Figure 1-2 shows the state's eleven water quality basins. New Mexico's surface waters include headwater portions of three of the nation's principal drainage systems: the San Juan River Basin and Lower Colorado River Basin contributes to the Colorado River; drainage from the Arkansas-White-Red River Basin contributes to the Mississippi River; and the three Rio Grande basins and the Pecos River Basin contribute discharge to the Gulf of Mexico. Other streams in the state are in topographically closed basins and drain internally (Water Quality Control Commission 1974).

Total annual stream flow averages over 5.7 million acre-feet, of which precipitation falling within the state boundaries contributes 3.3 million acre-feet. Other states, principally Colorado via the Rio Grande and the San Juan River, contribute the rest. Downstream states receive 3.6 million acre-feet from New Mexico (Bureau of Reclamation 1976).

Surface water quality varies from place to place. Generally, water originating in the high mountains is of excellent quality. At lower elevations, water is usually of lesser quality. High quality water is subjected to degradation as it flows downstream due to evapotranspiration, evaporation, anthropogenic pollutant loading, and its application to beneficial uses. Background information on surface waters is provided in Appendix A.

New Mexico's hydrogeology is highly variable and complex, and ground water quality and availability also varies from place to place. Sedimentary deposits (mainly sandstone, limestone, or unconsolidated sand and gravel) are the most productive aquifers. Valley-fill aquifers of major importance occur along the Rio Chama, the San Juan River, and the Pecos River. These aquifers are typically less than 200 feet thick and commonly provide water containing less than 1,000 milligrams per liter of total dissolved solids. A major basin-fill aquifer occurs in the Rio Grande Valley where basin-fill deposits attain thicknesses of up to 20,000 feet, although only the uppermost several thousand feet contain fresh water. This aquifer provides the only source of water for Albuquerque and a partial source for Santa Fe. Significant basin-fill aquifers also occur in the southwestern area of the state. The High Plains aquifer (primarily Ogallala formation) is a major water source along the eastern border of New Mexico. The Ogallala formation, the boundaries of which are roughly from Nebraska to New Mexico, is an example of a shared water source where states need to coordinate their efforts in terms of ground water pollution. Major sandstone aquifers are located in the San Juan Basin in the northwestern part of the state, and limestone aquifers are of importance in the southeastern part and locally in the central and western parts.

Many New Mexico aquifers are highly vulnerable to contamination from surface discharges. Maintenance of surface water quality is necessary to protect the state's ground water quality. The key risk factor for aquifer contamination is a shallow water table combined with a significant point or nonpoint source of pollution. In the urban areas of our state, abandoned, unplugged domestic wells (such as in Las Cruces and the South Valley in Bernalillo County) also add to the vulnerability to contamination. Other factors affecting ground water vulnerability include preferential flow pathways, clay and organic matter content of soils, and oxidation-reduction potential.

The magnitude of ground water supplies in the state is estimated to be 20 billion acre-feet. Of this amount, an estimated three billion acre-feet of fresh water and 1.4 billion acre-feet of slightly saline water are recoverable. In some areas with significant ground water use, ground water levels have declined due to withdrawals in excess of recharge (Bureau of Reclamation 1976).

New Mexico's ground water resources are of vital importance in sustaining life, and must be preserved for both present and futures generations. Approximately 90% of the total population of the state depends on ground water for drinking water. Eighty-one percent (81%) of the population is served by public systems with water derived from ground water sources. At least 150,000 people depend on private wells for drinking water. Nearly half of the total water annually withdrawn for all uses in New Mexico, including agriculture and industry, is ground water, the only practicable source of water in many areas of the state.About 4.4 billion acre-feet of recoverable fresh and slightly saline water are estimated to be present in underground storage in New Mexico. Overall, the quality of these waters is assumed to be good, although there are significant pollution problems known to affect certain areas throughout the state. A comprehensive survey of the state's ground water quality has not been done, so a quantitative statement concerning ground water quality cannot be made.

The state's surface water supply is almost fully applied to beneficial uses under existing rights or reserved for specified beneficial uses under water rights filings. The State Engineer had declared 33 underground water basins.

Water uses depend on both surface and ground water supplies. In 1990, total surface and ground water withdrawals totaled 4.2 million acre-feet and depletions (that portion of withdrawals permanently removed from the water supply) amounted to almost 2.6 million acre-feet. Of these totals, agriculture, excluding reservoir and stock pond evaporation, accounted for 3.4 million acre-feet (80%) of withdrawn water and just under two million acre-feet (75%) of the depletion. Public and private water supply wells extracted approximately 0.3 million acre-feet in 1990, and so accounted for only eight percent of total withdrawals. Ground water comprised 89% of the public and private water withdrawals and of agricultural withdrawals. The relative distribution of water uses can be expected to change in future years, as the growing sectors of the economy and an increasing population exert continued demands on this limited resource (Wilson 1992).

Figure 1-1. **Map of New Mexico**

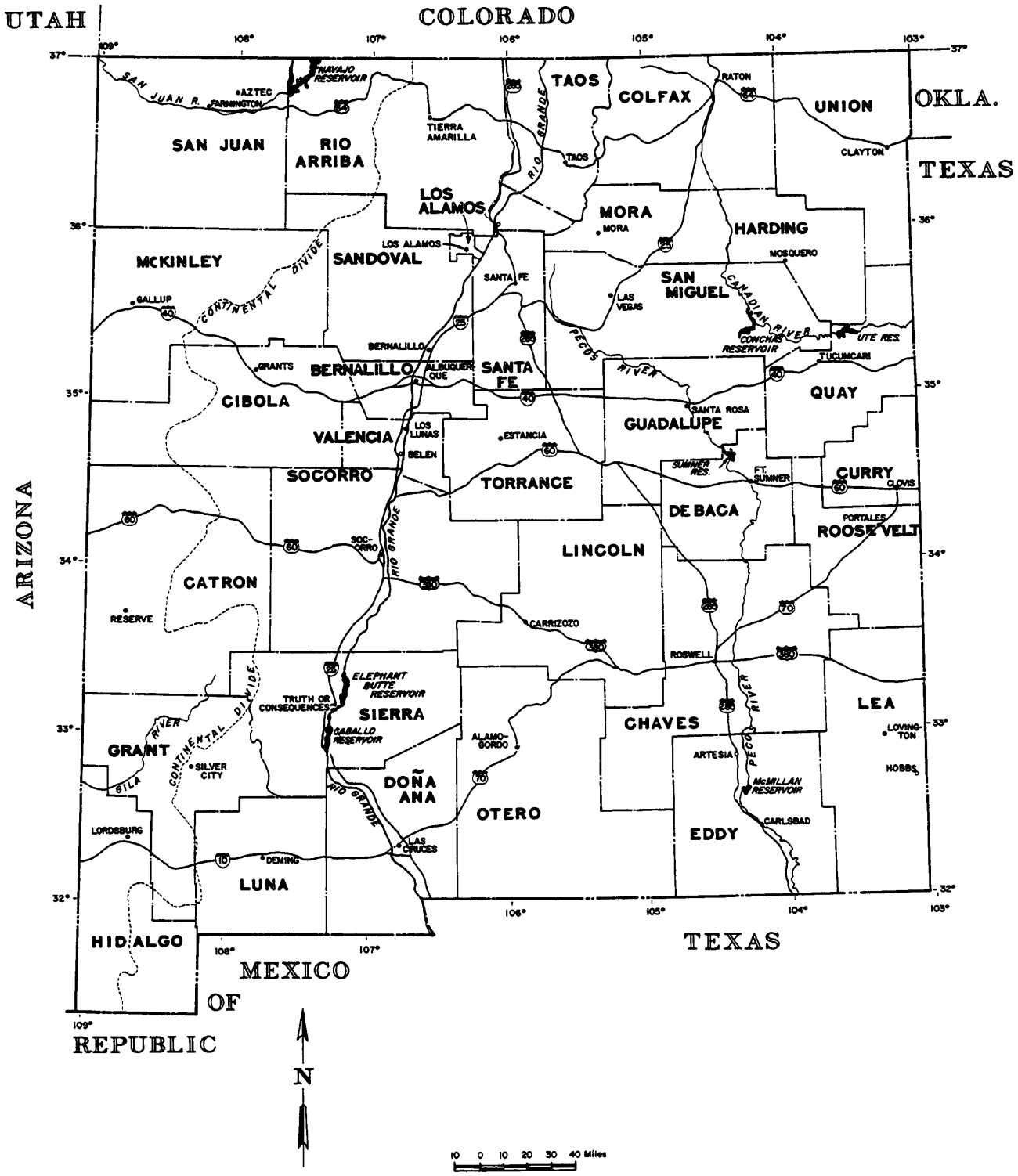
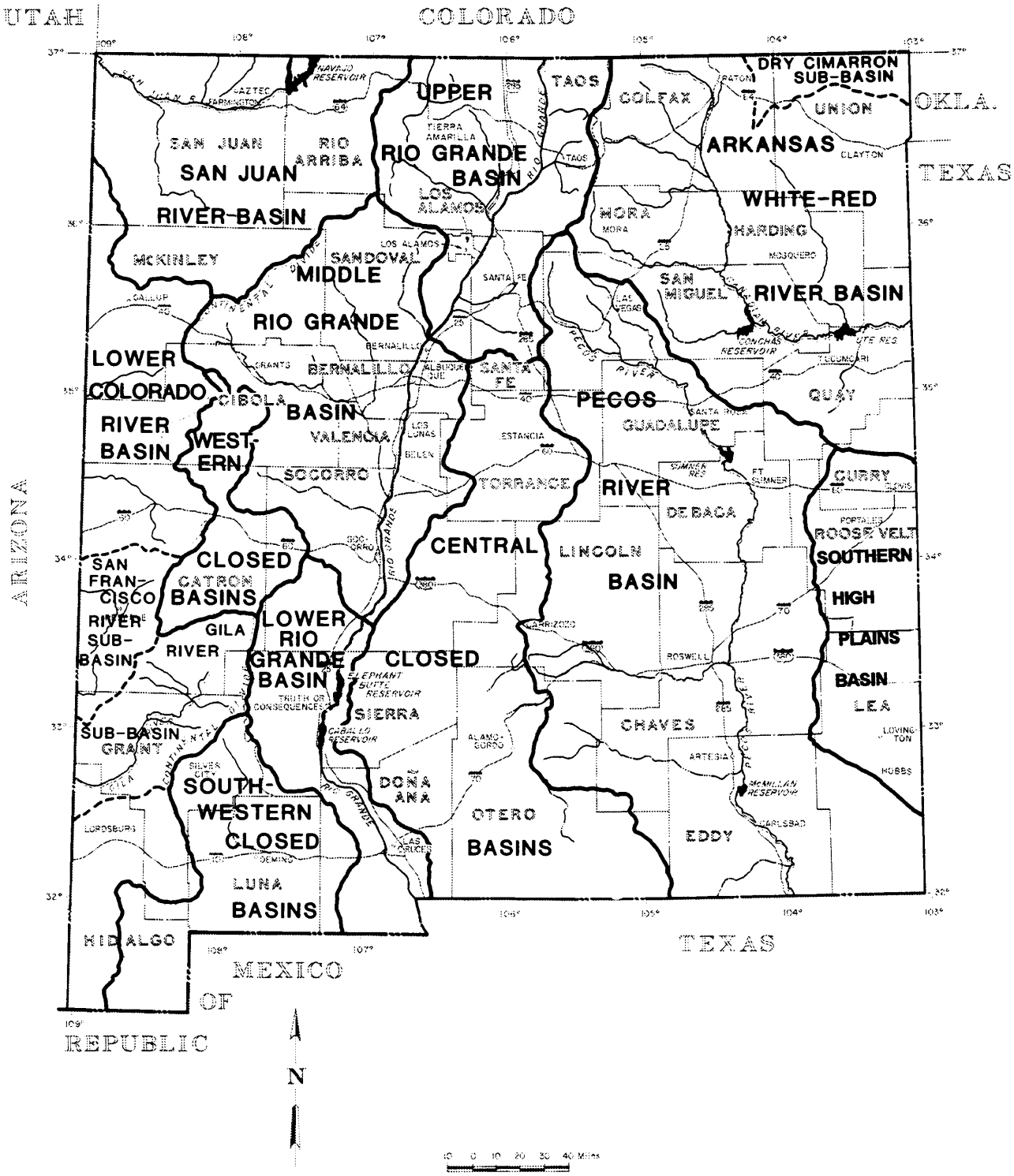


Figure 1-2. **Water Quality Basins in New Mexico**



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